CONSTRAINTS AND PERCEIVED SCOPE FOR PRACTICING SMALL SCALE AQUACULTURE

A Thesis
By

RATAN KUMAR ROY

MASTER OF SCIENCE
IN
AGRICULTURAL EXTENSION

DEPARTMENT OF AGRICULTURAL EXTENSION
HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR

JUNE 2014

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RATAN KUMAR ROY
Student No. 1305044
Session: 2013-2014
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ABSTRACT

Constraints and Perceived Scope for Practicing Small Scale Aquaculture

The research was undertaken to determine the extent of constraints as faced by the farmers engaged in small scale aquaculture, to explore the relationships of selected characteristics (independent variables) with constraints for practicing small scale aquaculture (dependent variable) and to find out the perceived scope for practicing small scale aquaculture. The independent variables were age, educational qualification, family size, farm size, area under aquaculture, knowledge of aquaculture, training received, annual income, income from aquaculture, extension media contact and organizational participation. The study was conducted in Ranisonkail upazila under Thakurgaon district. Ninety two (92) respondents were selected as sample from a list of 276 farmers using multi-stage random sampling method. Data were collected by a pre-tested interview schedule during 1st March to 30th April 2014. Among the total 19 constraints "unavailability of fish fries in proper time" occupied the highest (CFI= 229) score and stood top in the ranking while "disturbance from otter and predatory birds" had the lowest (CFI= 74) score. Slightly around three-fourths (72.8 percent) of the respondents had medium constraints, 18.5 percent had low constraints and 8.7 percent had high constraints for practicing small scale aquaculture. Majority farmers had faced medium constraints level in terms of general constraints, fish-culture constraints and post-harvest culture constraints. Scored Causal Diagrams (SCDs) explored that the main root causes to 'low practicing small scale aquaculture' identified were 'unavailability of fish fries in proper time'; 'lack of training and education' and 'rigid rules for getting credit' with score of 20, 20 and 11, respectively. Among the eleven selected characteristics of the farmer's farm size, area under aquaculture, knowledge of aquaculture, training received and extension media contact showed significantly negative relationship with the constraints. On the other hand age, educational qualification, family size, annual family income, income from aquaculture and organizational participation of the respondents did not show any significant relationship with their constraints. Main scope for practicing small scale aquaculture as mentioned by the respondents 'small scale aquaculture is profitable' followed by 'nutritional requirement' with PIS of 262 and 256 respectively.

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CHAPTER 1

INTRODUCTION

1.1 General Background

The people of Bangladesh have traditionally been identified with fish and rice which constitute the major items of their daily diet and fish ranks as the second staple food in their diet. Fish as a food item must have found favor with man at a very early stage of human history. The muscular tissue or flesh of a fish is made up of 60 to 82 percent water, about 13 to 20 percent protein and a greater or less amount of fat (Banglapedia, 2012). Fish supplements to about 60 percent of our daily animal protein intake. About 10 percent of the population is dependent directly or indirectly on the fisheries for their livelihood (Banglapedia, 2012).

The origin and development of aquaculture practices in Bangladesh are not well documented; historically the country's natural water bodies were stocked during the monsoon season through natural spawning. Fish farming had been a traditional practice dating back several centuries to when the country was ruled by Hindu kings. Many of the kings used to create ponds and tanks for drinking, bathing and sometimes for small scale irrigation. These ponds and tanks were also used for fish rearing, although more from a recreational aspect than for any commercial purposes. It was one Dr. Nazir Ahmed (1947-1960), then the Director of Fisheries in East Pakistan who laid the formal foundation for fish culture in ponds and lakes within Bangladesh (World Bank, 2013). Dr. Ahmed worked keenly on the development of large scale carp culture in ponds and lakes, and by the late sixties and early seventies some progress had been made in this area.

Aquaculture is one of the fastest growing animal food producing sectors in Bangladesh with an average annual growth rate of over 6 percent during the last three years (DoF, 2012). Bangladesh was the 5th largest global aquaculture producer in 2010 after China, India, Viet Nam and Indonesia (FAO, 2012). Total fish production of Bangladesh is 17.26 lakh MT in 2012 (FAO, 2014).

Bangladesh is considered one of the most suitable countries in the world for freshwater aquaculture, because of its favorable resources and agro-climatic conditions. In 2010-11 about 3.71 lakh ha of freshwater ponds with over 3 million farmers are involved in aquaculture. The total annual fish production in Bangladesh was estimated to be 3.06 million tons in 2010-11, of which 1.46 million tons (48 percent) were obtained from inland aquaculture, 1.05 million tons (34 percent) from inland capture fisheries and 0.55 million tons (18 percent) from marine fisheries. Within a decade, fish production has increased from 1.78 million tons in 2000-01 to 3.06 million tons in 2010-11 (DoF, 2012). Overall, aquaculture plays an important role in the economy of Bangladesh providing food, nutrition, incomes, livelihoods and export earnings (Dey *et al.*, 2010; Jahan and Ahmed, 2010 and Belton, 2011).

Fish contributes 60 percent of national animal protein consumption. Moreover, fish accounts for 4.43 percent of GDP and 2.73 percent of export earnings in 2011 (DoF, 2012).

Aquaculture in Bangladesh embraces a diverse range of aquatic resource fish culture, both land and water based, have been developed in the country over the past 20 years which include pond aquaculture (mostly semi-intensive), rice-fish culture, pen culture, shrimp gher (enclosure) farming, community based fisheries, cage culture etc. (Edwards, 2000). The sector is growing more rapidly than any other animal food producing sector in the country. The annual growth rate in aquaculture between 1990 and 2000 was 11.4 percent, compared to 4.9 percent for poultry, 2.5 percent for pork and 0.5 percent for beef over the past two decades. Aquaculture has been one of the most rapid and technically innovative food production sectors globally with significant investment, scientific and technical development and production growth. Its great potential to enhance food security, alleviate poverty, contribute to rural development and improving livelihoods is well recognized and likely to continue (Edwards, 2000).

Fish production from inland open water has been decreasing due to various reasons such as changing aquatic ecosystem, soil erosion, siltation in the river, construction of dam to control flood and irrigation, indiscriminate use of agro-chemicals, destructive fishing practices, over-fishing etc. Inland capture fishery contributed 51.5 percent of the total fish production in 1987-88; whereas in 2001-2002 it contributed 36.0 percent of the total production by the time contribution from inland culture fishery has increased in two folds from 10.8 to 42.0 percent (Azim *et al.*, 2002).

Small scale aquaculture represents the backbone of many rural communities in many countries and it forms the basis that provides livelihoods of many people living in the areas. The definition of small scale aquaculture varies from country to country. In the Bangladesh context, the small scale aquaculture is characterized by having:

a) Farming of aquatic organism with special emphasis on fish;

b) Extensive and low cost production technology;

c) Mostly appropriate for resource poor rural people;

d) Affordable to the poor consumers; and

e) Contributing to rural income, employment, nutrition and food security (Ray *et al.*, 2004).

Aquaculture plays a major role in nutrition, employment and foreign exchange earnings with about 12 million people associated with the fisheries sector, of which 1.4 million people rely exclusively on fisheries related activities (Shah, 1997). An estimated 9.5 million people (73 percent) are involved in subsistence fisheries on the country's flood plains (Azim *et al.*, 2002).

Among the small scale aquaculture landholders, 34 percent live below the poverty line. They have access to moderate amounts of land for farming (0.5-1.0 ha), often including fishpond, they tend cattle and small livestock, and live in basic houses. They do not produce much surplus. They may have some access to financial capital and credit, but are vulnerable to crisis conditions. Farmers in small scale aquaculture may also be categorized as medium sized landholders, those who possess l-2 ha of land, produce some surplus, and employ seasonal wage laborers (ADB, 2005).

Bangladesh provides a total pond water area of about 3.05 lakh hectares and the average rate of production from ponds 12.20 lakh MT are cultured by fish (DoF, 2012). The fish production of inland fisheries of Bangladesh has gradually increased from 11.40 lakh mt. in 2009-20010 to 12.20 lakh mt. in 2010-2011 (DoF, 2012). The culture fishery contributes over 47.71 percent of inland fish production covers only about 11 percent of the total inland water resources. It provides employment and income as well as accounting for 60-80 percent of the animal protein consumed by the population and are a major source of essential vitamins and fatty acids. Small scale aquaculture in the small ponds can be operated with resources available within the family. There an excellent opportunity for the development of small-scale aquaculture enterprise. Low input aquacultures are seen as an important tool for improving food security, especially in areas where there is a shortage of fresh fish. Small scale aquaculture provides reasonable cash income to the people, even though a part of the fish may be used for domestic consumption and thus contributes to the nutrition of family members. Many farmers and farming groups have been able to achieve such income and improve their overall standard of living.

1.2 Statement of the Problem

Aquaculture is a promising sector to fulfill the nutritional requirement as well as generate livelihood opportunities for poor people. Through small scale aquaculture the poor people are improved in their social and economic conditions. Small scale aquaculture production is profitable; concerns have arisen about the long term sustainability because many constraints hinder the progress of this sector. Overcoming the hindrance of small scale aquaculture the fish farmer carry out a profitable fish farming which endorses the economic development of the country. So find out the constraints in small scale aquaculture is prime necessity to explore the sector.

In view of the above circumstance, the study was undertaken with the title "Constraints and Perceived Scope for Practicing Small Scale Aquaculture". The study aimed at providing information regarding the following queries:

1. What are the constraints being faced by the farmers engaged in small scale aquaculture?
2. Which characteristics of the farmers are directly related to their constraints?
3. What are the perceived scopes by the small scale fish farmers?

1.3 Specific Objectives of the Study

In view of the above circumstances, the present study was undertaken keeping in view of the following objectives:

1. To determine the extent of constraints for practicing small scale aquaculture.
2. To determine and describe the socio-demographic characteristics of the respondents:
   i. Age
   ii. Educational qualification
   iii. Family size
   iv. Farm size
   v. Area under aquaculture
   vi. Knowledge of aquaculture
   vii. Annual income
   viii. Income from aquaculture
   ix. Training received
   x. Extension media contact
   xi. Organizational participation
3. To explore the relationship between the selected characteristics of the farmers and their constraints for practicing small scale aquaculture.
4. To identify the perceived scopes for practicing small scale aquaculture.

1.4 Justification of the study

In Bangladesh a large number of people suffer from malnutrition, so it is necessary to increase the supply of animal protein for ensuring balance diet. Fish contains comparatively cheaper protein and within the purchasing power of the poor people. But, deficit of fish production is due to various constraints in this sector. Fish production can only be increased if constraints are identified and minimized in small scale aquaculture. Therefore, proper knowledge of the aquaculture technologies of poly culture of carp, cultivation of pangus and nursery management in ponds should be disseminated to the farmers very earlier. The country has almost attained self-sufficiency in cereal food production (BARC, 2011). Small scale aquaculture provides reasonable cash income to the people, even though a part of the fish may be used for domestic consumption and thus contributes to the nutrition of family members. This study may facilitate to take up further studies of constraints for improvement of small scale aquaculture.

1.5 Scope of the study

The finding of the study would be especially applicable to Ranisankail upazila under Thakurgaon district. The findings however, would also have implication for other areas of the country having similarities with the study area. Thus, the findings are expected to be useful to the extension workers and planners for preparation of program for rapid diffusion of fisheries knowledge and technologies among the small scale fish farmers.

1.6 Assumption of the study

An assumption is "the supposition that an apparent fact principle is true in the light of available evidence" (Goode, 1945). The following assumptions were made in conducting the study:

a) The respondents included in the sample of the study were able to provide their opinions and were competent enough to satisfy the queries.

b) The information furnished by the respondents was reliable.

c) Views and opinions furnished by the respondents included in the sample were the representative views and opinion of the rural population of the concerned area.

d) The researcher who acted as interviewer was well adjusted to the social and cultural environment of the study area. Hence the respondents furnished their correct opinions without hesitation.

1.7 Limitations of the Study

In order to make the study manageable and meaningful from the point of view of research, it was necessary to impose some limitations as stated below:

a) The study was confined to four unions of Ranisankail upazila under Thakurgaon district.

b) The characteristics of the farmers are many and varied. But, only eleven characteristics were selected for investigation in the study.

c) Various constraints in small scale aquaculture are likely to be faced by the farmers. However, only nineteen problems have been considered for investigation in the study.

d) There were many farmers in the study areas but only those farmers who were involved in small scale aquaculture were selected.

e) The research had dependent on the data furnished by the selected respondents.

1.8 Definition of Important Terms

For the purpose of clarity, certain terms frequently used throughout entire study are defined and interpreted as follows:

Annual income

Annual income as defined as the total earning of the respondent and other members of his family from agriculture and other sources like, crops, vegetables, poultry, livestock, fisheries, business, wage labor, service etc. during a year.

Aquaculture

Aquaculture implies some form of intervention in the rearing process that leads to increased production, such as regular stocking or feeding or protection from predators; and the organisms must also be harvested by an individual or corporate body which has owned them throughout their rearing period (FAO, 1994).

Education

Education was defined as the formal education of a farmer. It was operationalized by the number of year spent to acquire formal education.

Extension media contact

The term extension media contact as used in this study refers to ones becoming accessible to the influence of extension program through different extension personnel.

Family size

Family size referred to the actual number of members in the family of a farmer including himself, his wife, spouse children and other dependents, which live and eat together in a family unit.

Farm size

The term was used to refer to the cultivated area either owned by a farmer or cultivated on *borga, lease* or other means. Farm size was measured in terms of hectares.

Homestead

A homestead is a land owned or occupied by a dwelling unit of the household along with adjoining area including gardens, courtyard and pond and threshing floor.

Knowledge on aquaculture

Knowledge on aquaculture referred to the farmers' knowledge about the different aspects of scientific management of fisheries. In this study, knowledge on aquaculture included knowledge in four aspects of fisheries namely, fish ponds, pond preparation, fertilizers-pesticides and rearing in general aspect. Moreover, knowledge about two technologies i.e. polyculture of ponds and Nursery management practices were also included.

Organizational participation

Organizational participation of a farmer referred to his taking part in different social organization either as an ordinary member or executive committee member within a specified period of time.

Respondent

Respondent referred to the fish farmers who were involved in aquaculture activities and were interviewed as a part of the sample of the present study.

CHAPTER 2

REVIEW OF LITERATURE

This Chapter deals with the review of past studies and findings related to the present study. In fact, very few research works have so far been done on constraints and perceived scope of small scale aquaculture. The present study is concentrated the constraints and perceived scope for practicing small scale aquaculture. The researcher therefore, made exhaustive effort to review the previous research work directly or indirectly related to the present study by different researcher in home and abroad. Literatures reviewed are presented below in three major sections. The first section deals with review of literature on general context of constraints, second section deals with the review of literature regarding relationship of selected characteristics of the respondents with their constraints and third and last section of this Chapter deals with the conceptual framework of the study.

2.1 Concept of Constraints and Literature Review on General Context of Constraints

2.1.1 Concept of constraint

Constraint is the element or factor of a subsystem that works as a bottleneck. It restricts an entity, project, or system (such as a manufacturing or decision making process) from achieving its potential (or higher level of output) with reference to its goal.

The constraint in technology transfer is those, which act as the barriers to the adoption of technologies by the potential users (Kashem and Halim, 1991). Constraints are the elements, which resist in doing some activities or operations in a certain field. Different authors have classified the constraints in different ways. Some of these are given below:

Kashem (2004) explained constraint in technology transfer mainly in three aspects:

- Social constraints
- Psychological constraints
- Situational constraints

Halim (2003) conducted a study on the "Constraints Faced by the Farmers in Adopting Crop Diversification". In his study, he selected five aspects of constraints viz.

- Socio-cultural and psychological constraints
- Economic constraints
- Situational and management constraints
- Constraints regarding inputs availability and constraints regarding extension services

2.1.2 General context of constraints

Noman (2012) conducted a study on constraints and scope for practicing sandbar cropping technology in riverine areas of Bangladesh. He found that low price during peak period of pumpkin, attack of insect and pathogen, lack of irrigation facilities, rotting of immature

pumpkin in the field, difficult to find out soil layer, requiring more labor in pumpkin cultivation in sandbar etc. are main constraints.

Mena *et al.* (2009) conducted in their study found that socio-economic, technological and farming constraints were more prominent than extension and marketing constraints.

Sohel (2007) found that pond fish productions profitable, concerns have arisen about the long-term sustainability due to multiple ownerships, lack of sufficient fund, high price of input, lack of marketing facilities, lack of scientific and technical knowledge, non-availability of fish seed water shortage in dry season etc. The study suggests some possible steps to remove these constraints.

Khan *et al.* (2007) in their study severe constraints like unavailability of electricity, higher input cost, limited source of information and unavailability of insecticides pesticides and fertilizers increase the cost of cultivation. They found that unavailability of electricity for irrigation was the most severe problem of the study area.

Singh *et al.* (2007) in their study revealed that training method was not effective, training subject was not match with current problems, and more distance from the village were the main constraints reported by the trained farmers.

Sawant and Nikam (2007) conducted a survey to study the constraints experienced by the veterinarians while communicating the information. Constraints like non availability of needed literature, lack of time and non-availability of funds were experienced in information input, processing and output.

Ray and Mondol (2004) in their study identified the major constraints of carp fish farming were dike overflow, natural disasters (flood, drought), water pollution, excessive rainfall, theft- multiple ownership problems, harvesting and marketing problems, lack of money , higher production costs, lower market price, poor quality of fish seed and lack of technical knowledge etc.

Karmaker (2004) found that majority of the farmers (44.8 percent) faced high constraints, while 39.60 percent faced medium constraints and 15.60 percent faced low constraints in adopting aquaculture technologies. Among the total constraints "lack of proper fund for fish culture" had the highest constraints facing index (CFI: 571) and the "using position in pond for inimical cause" had the lowest (CFI: 97). Realizing the enormous potential of intensified fish farming in Bangladesh, multiple ownership of pond area was found to be a major constraint of fish farming. Other problems identified were non-availability of fish fry, lack of technical training for the farmers, shortage of capital and the theft of fish or deliberate poisoning due to rivalry, or even jealousy.

Robbani (2002) conducted a survey of fisheries resources in Mymensingh, Jessore and Laxmipur region. Fish production of carps was found 1-2 tons acre/year. Inbreeding problems, lack of quality seed, inadequate technical l knowledge on scientific fish culture, incidence of fish disease, poor credit facilities, security, marketing, multiple ownership and feed were identified as the constraints to fish culture.

Agnew *et al.* (2002) found that the adoption of Harvesting Based Practice (HBP) (specially, lower pour rate and lower extractor fan speed balanced against harvest time) can provide an extra $ 100/ha to the industry. Several barriers to adoption of HBP include low sugar price, wet weather, orange rust disease, system of harvester payment, insufficient cane quality feedback mechanisms and physical, time and safety upon harvesting.

Islam (2001) conducted a study on farm youth of haor area of Mohongonj upazila. Study revealed that there were six top problems in rank order were (i) no arrangement of loan for the farm youth for fishery cultivation, (ii) lack of government programs in agriculture for the farming, (iii) absence of loan giving agencies for establishing farm in 1-0 daily, (iv) general people face problem for fishery due to government leasing of Jalmohal, (v) lack of government programs for establishing poultry farm.

Alam and Thomson (2001) examined the current status of fisheries in Bangladesh for each of the major sub sector, namely inland open water (aquaculture) and marine fisheries. They explained that production has been increased for all types of fisheries there are many constraints on expansion and it is difficult to identify significant achievement from government policy efforts, a host factor are responsible for the underutilization of fishing areas, including resources limitations, poor implementations of fisheries laws, the limited spread of fish farming technology, low financial capacities and ineffective production practices.

Sultana (2001) found that the farmers of Trisal upazila made profits from both polyculture and carp nursery technologies, the study has also revealed that the carp nursery was more profitable (TK.1,01,444 ha^{-1}) than the production of polyculture (T.K 50,021 ha^{-1}). The study has also identified some major problems associated with economic, technical and social aspects that had been facing by the producers in adopting polyculture and carp nursery technologies.

2.2 Relationship between Independent Variables and Constraints for Practicing Small Scale Aquaculture

From repeated searching the researcher did not find the relevant literature pertaining relationship of income from aquaculture with dependent variable. The relationships of remaining ten independent variables with dependent variable are given below:

2.2.1 Age and constraints

Noman (2012) found that there was positive relationship between age and constraints of sandbar cropping technology.

Parvez (2009) observed a positive relationship between age and constraints faced by the farmers in small scale aquaculture.

Khan *et al.* (2007) observed that age of the farmers had positive relationship with the constraints faced by the farmers in agriculture.

Hasan and Anwarul (2005) found that there was no relationship between age of the farmers and their problem confrontation in using quality rice (BR 11) seed. Similar findings were obtained by Nahid (2005) and Halim and Anwarul (2003) in the study.

Karmakar (2004) in his study found a positive and significant relationship between of the farmers and their constraints in banana cultivation. Similar findings were obtained by Bhuyian (2002) in his study.

Rashid (2003) found- that rural-youth had significant negative relationship with their problem confrontation in undertaking selected agricultural activities.

2.2.2 Educational qualification and constraints

Noman (2012) found a positive relationship between educational qualification and constraints of sandbar cropping technology.

Parvez (2009) observed that educational qualification had negative significant relationship with constraints faced by the farmers in small scale aquaculture.

Khan *et al.* (2007) conducted a study to carry out the constraints and problems faced by the farmers in agriculture. They found that education had significant negative relationship with the constraints faced by the farmers of the study area.

Karmakar (2004) in his study found a negatively significant relationship between of the farmers and their constraints hi adopting aquaculture techniques.

Halim (2003) in his study on the constraints faced by the farmers in adopting crop diversification found that there is no relationship between education and heir problem confrontation.

Similar findings were obtained by Nahid (2005) and Bhuyian (2002) their respective studies.

2.2.3. Family size and constraints

Noman (2012) found that there was negative relationship between family size and constraints of sandbar cropping technology.

Parvez (2009) found a positive significant relationship between family size and constraints faced by the farmers in small scale aquaculture

Karmakar (2004) found that family size of the farmers had significant positive relationship with their constraints in adopting aquaculture technologies. Similar findings were obtained by Salam (2003) in the study.

Halim (2003) found that there was no significant relationship between family size and problem confrontation of the Mohila Bittaheen Samabay' Samittee.

2.2.4 Farm size and constraints

Parvez (2009) found in his research work that there was no significant relationship between farm size and constraints faced by the farmers in small scale aquaculture.

Hasan and Anwarul (2005) found a significant and negative relationship between area under cotton cultivation of the farmers and the constraints faced by them. Similar findings were obtained by Nahid (2005) in the study.

Karmakar (2004) in his study found no significant relationship between farm size of the farmers and their constraints in adopting aquaculture techniques. Similar were obtained by Rashid (2003) their respective studies.

Halim (2003) in his study conducted that the respondents' area under rice cultivation had a positive relationship with their constraints in adoption of crop diversification.

2.2.5. Area under aquaculture and constraints

Parvez (2009) and Karmakar (2004) in his study found no significant relationship between pond area of the farmers and their constraints in adopting aquaculture techniques. Similar findings were obtained by Bhuyian (2002) in the study.

Nahid (2005) found that sugarcane farm size of the sugarcane growers had negative significant relationship with their problem confrontation in sugarcane production.

Halim (2003) in his study constraints faced by the farmers in adopting crop diversification found that there was positive and significant relationship between area under rice cultivation of the farmers and heir problem confrontation.

2.2.6. Knowledge of aquaculture and constraints

Noman (2012) found that there was negative relationship between knowledge of sandbar cropping and constraints of sandbar cropping technology.

Parvez (2009) found in his research work that there was negative significant relationship between knowledge of aquaculture and constraints faced by the farmers in small scale aquaculture.

Nahid (2005) reported that the knowledge of aquaculture had no significant relationship with their constraints in cotton cultivation faced by the farmers. Similar finding was obtained by Salam (2003) in his studies.

Karmakar (2004) in his study found significant negatively relationship between knowledge of the farmers in banana cultivation and their faced constraints in banana cultivation. Similar finding was obtained by Bhuyian (2002) in the study.

2.2.7. Annual income and constraints

Noman (2012) found that there was negative relationship between annual income and constraints of sandbar cropping technology.

Parvez (2009) found in his research work that there was negative significant relationship between annual income and constraints faced by the farmers in small scale aquaculture.

Nahid (2005) in his study found negatively significant relationship between annual income of the farmers and then constraints in adopting aquaculture techniques. Similar findings were obtained by Karmakar (2004) in the study.

Salam (2003) in his study found no significant relationship between annual income of the farmers and their constraints in banana cultivation. Similar findings were obtained by Halim (2003) and Bhuyian (2002) in their respective studies.

2.2.8 Income from Aquaculture and Constraints

After through searching, no information was found on this aspect. Hence, it was not possible to put relationship in this context.

2.2.9 Training received and constraints

Noman (2012) found that there was negative relationship between training received and constraints of sandbar cropping technology.

Halim (2003) found that there was negative significant relationship between training received and constraints faced by the farmers in adopting crop diversification.

Ahmed (2002) showed that training exposure of the farmers had significant negative relationship with their problem confrontation in jute seed production.

Ali (1999) found that training experience of the rural youth had no relationship with their anticipated problem confrontation in self-employment by undertaking selected agricultural income-generating activities. Similar finding was obtained by Saha (1997).

2.2.10 Extension media contact and constraints

Parvez (2009) found in his research work that there was negative significant relationship between extension media contact and constraints faced by the farmers in small scale aquaculture.

Halim (2003) found in this study that extension contact of the members of Mohila Bittaheen Samabaya Samittee had no significant relationship on their problem confrontation.

Salam (2003) in this study concluded that extension contact of the farmers had significant negative relationship with their faced constraints in cotton cultivation. Similar findings were obtained by Bhuyian (2002) and Rahman (1996) in their respective studies.

2.2.11 Organizational participation and constraints

Parvez (2009) found in his research work that there was no significant relationship between organizational participation and constraints faced by the farmers in small scale aquaculture.

2.3 The Conceptual Framework of the Study

The conceptual framework is the foundation for understanding the research issues and linkages among the different variables. The conceptual framework of Rosenberg and Hovland (1960) was kept in mind while framing the structural arrangement for the dependent and independent variables. The main focus of the study will the constraints faced by the farmers in small scale aquaculture which will consider as the dependent variable and eleven selected characteristics of the farmers as independent variables. Constraints of an individual may affect through interacting focuses of many independent variables. It is not possible to deal with all independent variables in a single study. It was therefore, necessary to limit the number of independent variables which include age, educational qualification, family size, farm size, area under aquaculture, knowledge of aquaculture, training received, annual income, income from aquaculture, extension media contact and organizational participation.

In order to have a clear understanding of the dependent variables the constraints faced by the farmers was considered from the view of three aspects. These are general constraints, cultural constraints and constraints after harvest.

Based on these discussion and review of literature, the conceptual framework of the study has been formulated as shown in Figure 2.1.

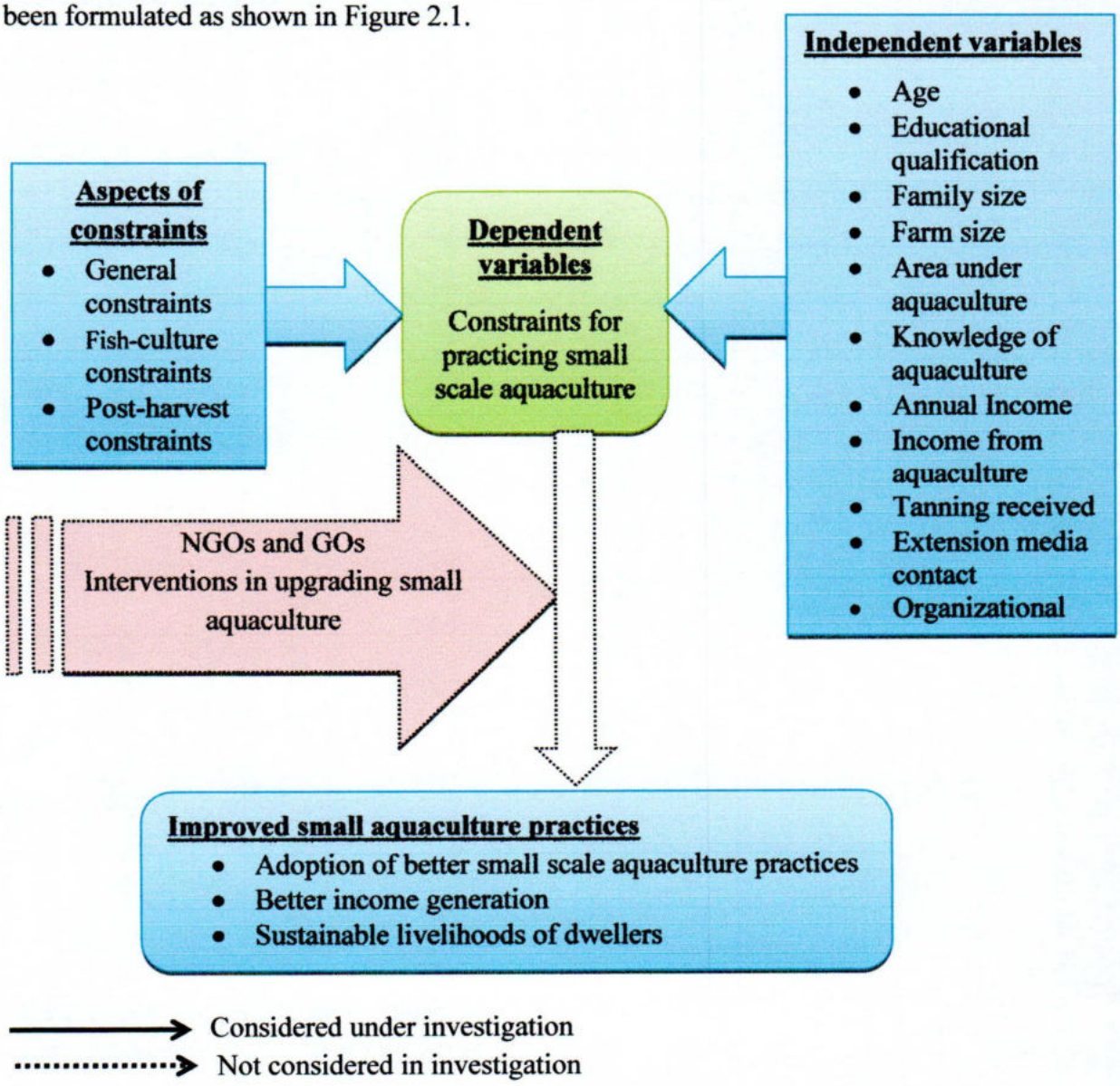

Figure 2.1 The conceptual framework of the study

CHAPTER 3

METHODOLOGY

Methodology deserves a very careful consideration in a scientific research. It enables the researcher to collect valid and reliable information to analyze the same properly and to arrive at appropriate decisions. Methods and procedures followed in conducting this study have been discussed in this Chapter.

3.1 Locale of the Study

There were five upazilas in Thakurgaon district among which Ranisonkail upazila was selected randomly as the locale of the study. Ranisankail upazila consists of eight unions: Rator, Nekmarad, Bachor, Nonduar, Dharmagarh, Hossaingaon, Lehemba and Kashipur. Four union ie. Nakmarad, Bachor, Hossaingaon and Lehemba were selected randomly. Map of Thakurgaon district and Ranisonkail upazila including its unions have been presented in Figure 3.1 and Figure 3.2, respectively.

3.2 Population and Sample of the Study

In the study area, a good number of farmers earn their livelihoods from carp farming and its associated activities. All the small scale aquaculture farmers of these four unions were the population of the study. An up-to-date list of fish farmers was collected from the concerned Upazila Fisheries Officer (UFO). In this study, a total of 276 fish farmers constituted the population. To make a representative sample, one-third of the population was selected randomly and proportionately from the population of each of the unions. Thus, the sample size so drawn stood at 92. A reserve list of 10 farmers was also selected for unavailability of sample farmers during interview. Distribution of respondents constituting the population, sample and reserve list in selected four unions under Ranisankail upazila is presented in Table 3.1.

Table 3.1 Distribution of population and sample

Union	Population	Sample size	Reserve list
Nekmarad	63	21	2
Bachor	72	24	3
Hossaingaon	75	25	3
Lehemba	66	22	2
Total	276	92	10

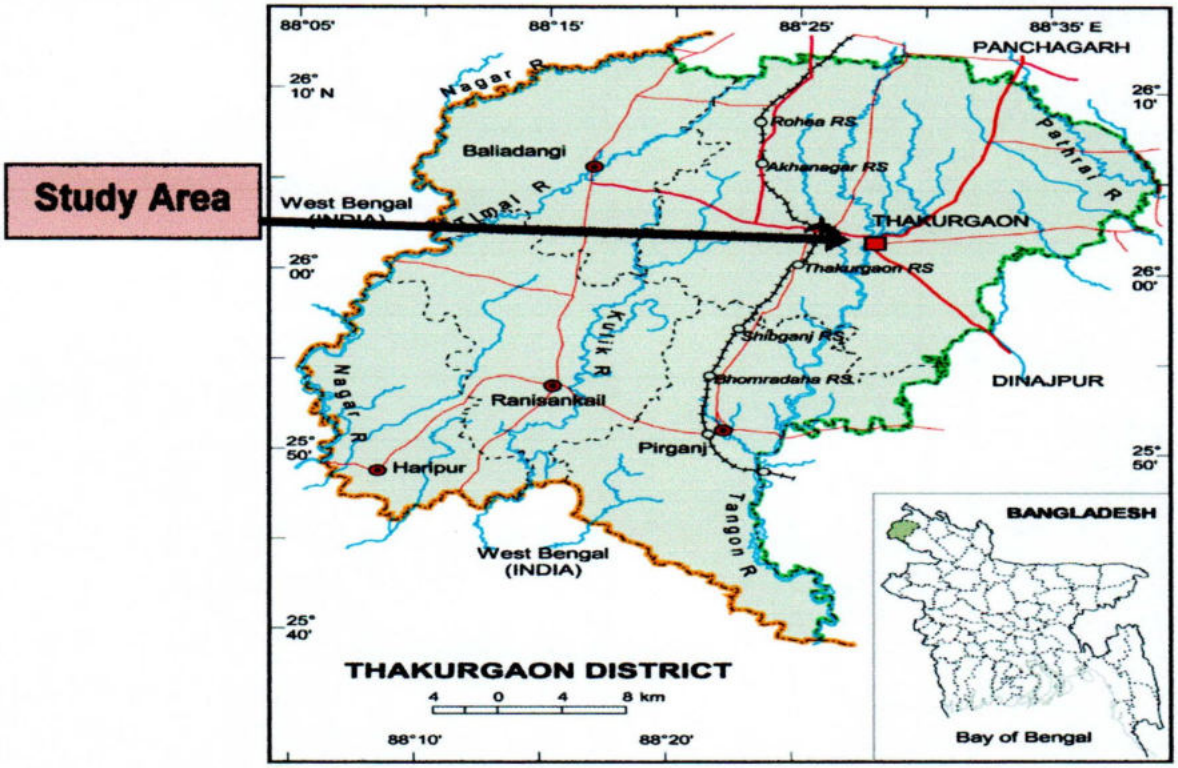

Fig. 3.1 A map showing the study area of Thakurgaon district.

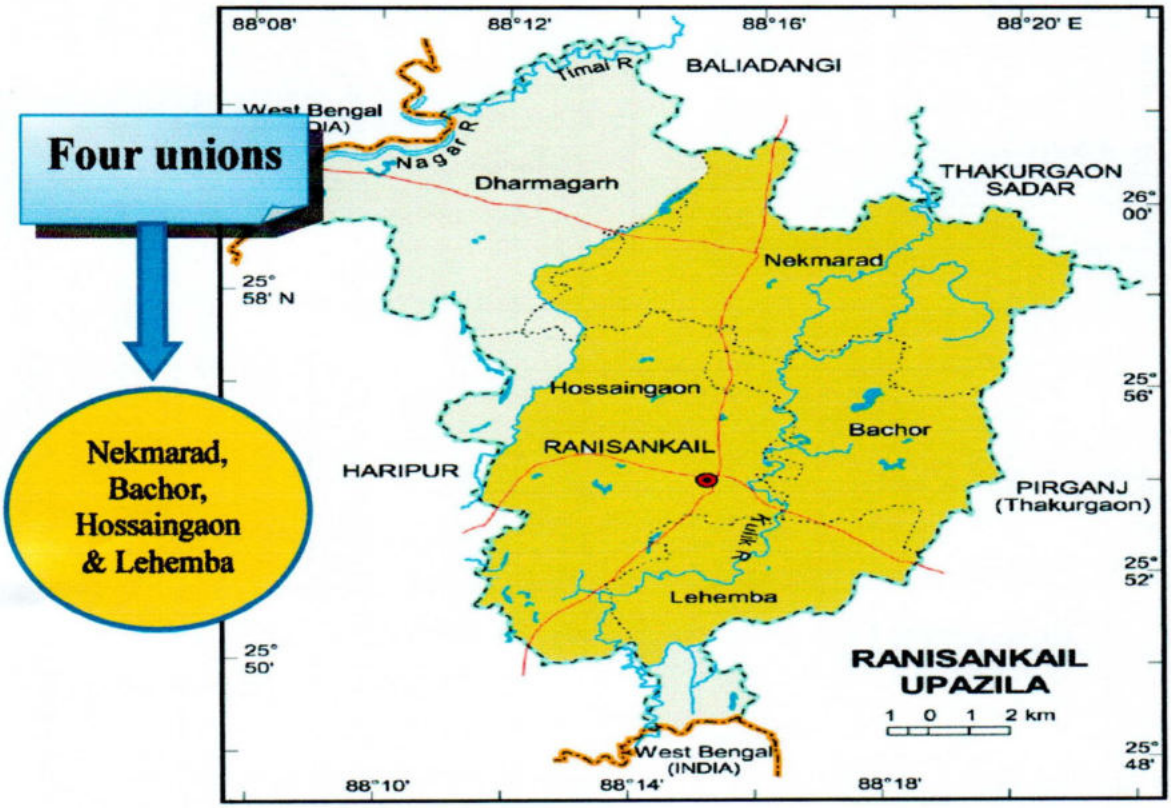

Fig.3.2 A map showing the study areas of Ranisankail upazila

3.3 Instrument for Data Collection

For collecting data, an interview schedule was prepared according to objectives of the study. Closed and open form questions were included in the interview schedule. The questions included were simple and direct to ascertain the opinion of the farmers regarding a number of aspects. A draft interview schedule was prepared in accordance with the objectives of the study. The interview schedule was pre-tested with 20 respondents of the study area before finalization for data collection. Based on the pre-test result, necessary corrections, additions and modifications were made in the interview schedule. The modified, corrected and adjusted interview schedule was printed in the final form in English (Appendix A) which was translated to Bengali version for clear understanding of the respondents and enumerator. Focus Group Discussions (FGDs) were arranged with the selected small fish farmers at the homestead. These group discussions were organized to identify and cross-check the constraints for practicing small scale aquaculture. Finally, data were collected from the study area during 1st March to 30th April 2014.

3.4 Selection of Variables

The researcher employed adequate sincerity and care in selecting the variables of the study. Considering time and resources available for the research, reviewing relevant literature as far as available, discussed with the teachers and experts in the relevant fields, the variables were selected for the study. Constraints for practicing small-scale aquaculture were the main focus of this study and it was considered as the dependent variable. In the present study, the selected independent variables were: age, educational qualification, family size, farm size, area under aquaculture, knowledge of aquaculture, annual income, income from aquaculture, training received, extension media contact and organizational participation.

3.5 Measurement of Variables

3.5.1 Measurement of dependent variable

Constraints faced by farmers in small scale aquaculture were the dependent variable of the study. The researcher classified the constraints faced by the farmers in 3 different aspects viz. general constraints, fish-culture constraints and post-harvest constraints.

3.5.1.1 Measurement of overall constraints score

An overall constraints score of small scale aquaculture was computed for each farmer by adding his constraints scores in all 19 constraints items. Each farmer was asked to indicate the extent of difficulty caused by each of the constrains by checking any of 4 responses such as 'high', 'medium, 'low', 'not at all' and weight were assigned to these responses as 3, 2, 1 and 0, respectively. Thus the possible range of constraints facing score for each constrains can rang from 0 to 3 and the possible range of overall constraints facing score for 19 constraints can range from 0 to 57. Here, 0 indicates no constraints for small scale aquaculture practice and 57 indicate very high constraints for small scale aquaculture practice.

3.5.1.2 Measurement of different aspects of constraints

For having a clear understanding of overall constraints faced by the farmers in small scale aquaculture, ones need an idea about their faced constraints in each of the general constraints, fish-culture constraints and post-harvest constraints. Different aspects of constraints were measured on the basis of constraint items. Thus, the possible score range of different aspects were as follows in Table 3.2.

Table 3.2 Different aspects of constraints

Name of aspects	Number of constraints	Possible range
General constraints	6	0-18
Fish-culture constraints	10	0-30
Post-harvest constraints	3	0-9

3.5.1.3 Comparison among the constraints

A Constraints Facing Index (CFI) for each nineteen selected constraints was computed by using the following formula:

$CFI = (C_h \times 3) + (C_m \times 2) + (C_l \times 1) + (C_n \times 0)$

Where,

C_h= Number of responses indicating high constraints

C_m= Number of responses indicating medium constraints

C_l= Number of responses indicating low constraints

C_n= Number of responses indicating no constraints

Similar formula was also used by Noman (2012), Parvez (2009) and Karmaker (2004) in preparing Constraint Facing Index (CFI).

Scored Causal Diagrams (SCDs) of Participatory Farm Management (PFM) were used to cross-check constraints for practicing small scale aquaculture (Galpin *et al.*, 2000). SCDs were used to examine in detail the causes and effects of constraints and to identify the 'root' causes which need to be addressed and to analyze the relative importance of the constraints and prioritize them.

Firstly, constraints for practicing small scale aquaculture were critically discussed with the participants in a small group containing six members in order to construct the SCDs. Secondly, different constraints given by the small scale fish farmers were listed through discussion. Assuming the end constraint 'low practicing of small scale aquaculture' and writing it on an elliptical card, they were asked to mention the direct causes of this constraint. Then arrows were drawn to represent the causal relationships between the problems as the direct causes were identified and written on separate cards by the farmers, the cards were placed on a large paper on the ground. Each constraint was represented on the ground once only. The causes of those constraints were identified and added to the diagram. These might be from the original list or might be newly identified. Finally, the process was continued until

the participants were satisfied that all the problems had been included and all the connections identified. The constraint at the edge of the diagram with no identified 'causes' were determined as the 'root' causes. Scoring was done by moving counters (bean seeds) up from the end constraint by dividing them between the causes of each subsequent constraint. One hundred bean seeds were used as counters as the total score for the end constraint.

The procedural steps of scoring used in this research study were as follows:

1. Even number (100) of bean seeds was placed on the end constraint after drawing the causal diagram.
2. To represent how important the causes of that constraint, farmers were asked to divide the 100 seeds between the causes of that constraint (i.e. the arrows entering the constraint).
3. The scores were then taken back a further step and divided between the causes of the next constraint using the same procedure as in step-2.
4. There was no arrow entering the constraint if no causes of the constraint had been identified on the diagram and the score remained on that constraint. If there was only one cause of the constraint, the whole score is moved back to that cause. The scores were written on the diagram at each stage before the seeds were moved on.
5. If a cause had more than one effect, then the scores from those effect arrows were added together. This total was then divided between the different causes of the constraint, as in step-
6. The scoring was continued until all the constraint on the diagram had been scored. The beans were ended up on the 'root' causes.
7. The relative scores of the 'root' causes were compared on completion of the scoring process. The higher the score the more important the constraint. These scores and the reasoning behind the scores (i.e. the causes and effects on the diagram) were clarified with the participants.

3.5.2 Measurement of Independent Variables

The eleven selected characteristics of the respondent's constitute the independent variables of this study were: age, educational qualification, family size, farm size, area under aquaculture, knowledge of aquaculture, annual income, income from aquaculture, training received, extension media contact and organizational participation. The procedure followed for measuring these selected characteristics are presented below:

3.5.2.1 Age

Age of the respondents were measured in terms of years from his birth to the time of interview was taken. A score of one was assigned for each year of age. It was measured in a complete years on the basis of responses of the respondents. This variable has been mentioned in question number 1 of the interview schedule (Appendix-A).

3.5.2.2 Educational qualification

Years of schooling was used to measure educational qualification completed by an individual from any educational institutes. If a respondent did not know how to read and write his score was taken as zero (0). A score of 0.5 was assigned to that respondent who could sign his name only. Besides this, a respondent was given actual score of one for every year of schooling i.e. 1 for class one, 2 for class two and so on. This variable has been mentioned in question number 2 of the interview schedule (Appendix-A).

3.5.2.3 Family size

Family size of the respondent was measured on the basis of the number of family members including himself, his wife, children and other dependents living in a nuclear family. For example, if a respondent had five members in his family the score of the family size was taken as five. This variable has been mentioned in question number 3 of the interview schedule (Appendix-A).

3.5.2.4 Farm size

The farm size was measured by the area of the land in which the household of the respondent had its entire dwelling unit including homestead area under cultivation and others (Sarker, 2005). It was expressed in hectare. The total area of land thus obtained has been considered as farm size of the respondent. It was measured using the following formula:

Farm size: $F_1+F_2+ 1/2(F_3+ F_4)+F_5 +F_6$

Where,

F_1= Homestead land

F_2= Own land under own cultivation

F_3= Pond taken from others on share/Share cropping/Leased/Mortgaged in

F_4= Pond taken from others on lease/Share cropping/Leased/Mortgaged out

F_5= Pond area

F_6= Others (specify)

This variable has been mentioned in question number 4 of the interview schedule (Appendix-A).

3.5.2.5 Area under aquaculture

Area under Aquaculture of a respondent was measured in hectares using the following formula:

$AUA=A_1+A_2+A_3$

Where,

AUA= Area under Aquaculture

A_1=Own pond

A_2=Pond taken from others on share

A_3= Pond taken from others on lease

The data was first recorded in term of local unit and then converted into hectare.

This variable has been mentioned in question number 5 of the interview schedule (Appendix-A).

3.5.2.6 Knowledge of aquaculture

For measuring aquaculture knowledge of a respondent, the researcher followed the Bloom's Taxonomy of Cognitive Domain which was modified and revised by (Anderson and Krathwohl, 2000). In this case, knowledge were measured by asking 18 questions on 6 aspects i.e. remembering, understanding, applying, analyzing, evaluating and creating capacities of the respondents about aquaculture. For correct response to all 18 questions considering the level of difficulty, different scores were assigned. Thus, knowledge of aquaculture of the respondents could be ranged from 0 to 46, where 0 indicate no knowledge and 46 indicate high knowledge on aquaculture. This variable has been mentioned in question number 6 of the interview schedule (Appendix-A).

3.5.2.7 Annual income

The annual family income of a respondent was measured in taka and was taken 1 (one) for every 1,000/- of annual family income on the basis of total yearly earning of the respondents and member of his/her family. For determining the annual family income of a respondent from fisheries sector, it was first necessary to identify his annual production from different fisheries sectors, livestock and poultry sectors etc. The price of each unit was determined on the basis of market price at the time of interviewing. Income from other sources like business, labor etc. of each respondent and other members of family was also determined. This variable has been mentioned in question number 7 of the interview schedule (Appendix-A).

3.5.2.8 Income from aquaculture

Income from aquaculture of a respondent was measured in terms of percent of total income. This variable has been mentioned in question number 8 of the interview schedule (Appendix-A).

3.5.2.9 Training received

Training received was determined by total number of days a respondent received training in his/her entire life. For example, if a respondent received three (3) days training then the score was given 3 and so on. This variable has been mentioned in question number 9 of the interview schedule (Appendix-A).

3.5.2.10 Extension media contact

Extension media contact of a respondent was measured by computing an extension media contact score on the basis of his/her frequency of contact with selected extension media. The frequency of contact with an information source was classified into four categories as 'regularly', 'occasionally', 'very low' and 'never' and a weight of 3,2,1 and 0 assigned to these categories, respectively. This variable has been mentioned in question number 10 of the interview schedule (Appendix-A).

3.5.2.11 Organizational participation

Organizational participation score of a respondent was measured on the nature of his /her involvement and duration in different organization of participation as a general member, an executive member and as a executive officer with selected organization. Organizational participation scores was measured using the following formula:

Organizational Participation Scores= $P_{gm} \times N_1Y_1 + P_{em} \times N_2Y_2 + P_{eo} \times N_3Y_3$

Where,

P_{gm} = Participation as a general member

P_{em} = Participation as an executive member

P_{eo} = Participation as an executive officer

Organizational participation score was measured as followed:

Nature of Participation	Scoured
Not at all	0
Participation as a general member	1
Participation as an executive member	2
Participation as an executive officer	3

Also, N_1, N_2, N_3 refer to nature of organization to which respondents had been associated as a general member, as an executive member and as an executive officer and Y_1 ,Y_2, Y_3 refer duration of participation in year in the same order. This variable has been mentioned in question number 11 of the interview schedule (Appendix-A).

3.5.2 Perceived scope for practicing small scale aquaculture.

A group of 20 respondents to identify the perception of scope for practicing small scale aquaculture a Focus Group Discussion (FGD) was conducted. The group was divided into four sub-groups and each sub-group was asked about their perception regarding scope for practicing small scale aquaculture. Each group was allowed to work through discussion among themselves. One of the group members was selected to list down the perception about the scopes for practicing small scale aquaculture. Each group was closely monitored. After completing the discussion, all identified perceived scopes were listed and finally included in the interview schedule. The respondents were asked to indicate the importance of their perception about scope by mentioning whether it was high, moderate, low or not at all with the corresponding scores of 3, 2, 1, 0 respectively. A 'Perception Index of Scope' was prepared for analyzing the degree of severity using the following formula (Noman, 2012):

$PIS = f_h \times 3 + f_m \times 2 + f_l \times 1 + f_n \times 0$

Where,

PIS = Perception Index of Scope

f_h= frequency of respondents mentioning the perception of scope as 'high'

f_m= frequency of respondents mentioning the perception of scope as 'moderate'

f_l= frequency of respondents mentioning the perception of scope as 'low'

f_n= frequency of respondents mentioning the perception of scope as 'not at all'

3.6 Statement of Hypothesis

In order to guide relevant data collection, analysis and interpretation of data, a set of hypothesis was formulated for empirical testing. The following null hypothesis was formulated to test the relationship of 11 selected independent variables of farmers faced constraints for practicing small scale aquaculture.

There is no relationship between the constraints faced by the farmers in small scale aquaculture and each of their eleven selected characteristic. The characteristics were age, education qualification, family size, farm size, area under aquaculture, knowledge of aquaculture, annual income, income from aquaculture, training received, extension media contact and organizational participation.

3.7 Collection of data

The researcher himself was collected data from the sampled farmers by using personal interview schedule from 1st March to 30th April, 2014. Before starting collection of data, the researcher met the respective District Fisheries Officer (DFO), Upazila Fisheries Officer (UFO) and Upazila Assistant Fisheries Officer (UAFO). The researcher also discussed the objectives of the present study with the respondents so that they did not hesitate to answer at the time of interview. The researcher took necessary care to explain the issue as far as possible.

3.8 Data Processing and Analysis

The collected data was compiled, tabulated, coded and analyzed for statistical analysis according to the objectives of the research. Descriptive statistic such as range, mean, number, percentage, standard deviation and rank order was used wherever necessary in describing the selected variables. Pearson's Product Moment Correlation Co-efficient (r) was used to examine the relationships of independent variables for practicing small scale aquaculture (dependent variable). Statistical Package for Social Science (SPSS) was used to analyze the data.

CHAPTER 4

RESULTS AND DISCUSSION

This Chapter has been divided into four separate sections for proper statistical analysis along with their logical interpretations. The first section deals with the extent of constraints (dependent variable) as faced by the respondents. The second section deals with the description of selected individual characteristics of the farmers' (independent variables) of the study. The third section deals with the relationships between constraints for practicing small scale aquaculture and the selected characteristics of the respondents. The last section deals with the determination of perceived scope for practicing small scale aquaculture.

4.1 Constraints in Small Scale Aquaculture

4.1.1 Overall constraints in small scale aquaculture

The respondent's constraints facing scores in all 19 selected constraints could range from 0 to 57. However, the observed constraints scores ranged from 26 to 52 with an average of 42.14 and standard deviation of 5.67. Based on their overall constraint scores, the respondents were classified into three categories as low (up to 36), medium (37-48) and high (>48) constraints.

Table 4.1 Categorization of the respondents according to their overall constraints facing in small scale aquaculture

Range		Categories	Respondents		Mean	SD
Possible	Observed		Frequency	Percent		
0-57	26-52	Low (up to 36)	17	18.5	42.14	5.67
		Medium (37-48)	67	72.8		
		High (>48)	8	8.7		

Data in above Table 4.1 indicate that majority (72.8 percent) of the respondents had medium constraints while 18.5 percent had low constraint and only 8.7 percent had high constraints in small scale aquaculture. The majority of the farmers (91.3 percent) clearly indicate that they faced low to medium constraints in small scale aquaculture.

4.1.2 Constraints in different aspects of aquaculture

For having a clear understanding of the constraints faced by the farmers in small scale aquaculture, the present study analyzed the constraints in three aspects, namely general constraints, fish-culture constraints and post-harvest constraints. A summary of findings on this regard has been presented in Table 4.2.

Table 4.2 Categorization of respondents based on their constraints in different aspects

Aspect of constraints	Categories	Respondents		Range		Mean	SD
		Frequency	Percent	Possible	Observed		
General constraints	Low (up to12)	20	21.7	0-18	7-17	13.98	2.19
	Medium (13-16)	61	66.3				
	High (>16)	11	12.0				
Fish-culture constraints	Low (up to 18)	20	21.7	0-30	13-28	20.97	3.12
	Medium (19-24)	63	68.5				
	High (>24)	9	9.8				
Post-harvest constraints	Low (up to 6)	23	25.0	0-9	4-9	7.18	1.33
	Medium (7-8)	57	62.0				
	High (>8)	12	13.0				

Data in above Table 4.2 shows as general constraints majority of the farmers 66.3 percent had medium constraints level, 21.7 percent had low constraints level and remaining (12.0 percent) had high constraints level. In fish-culture constraints 68.5 percent had medium constraints level, 21.7 percent had low constraints level and remaining (9.8 percent) had high constraints level. In case of post-harvest constraints 62.0 percent had medium constraints level, 25.0 percent had low constraints level and remaining (13.0 percent) had high constraints level.

4.1.3 Comparison among the individual constraints

For having the better understanding regarding small fish farmers' constraints in practicing small scale aquaculture, it was necessary to have an idea about the comparative constraint facing in 19 selected constraints. For this purpose, a Constraint Facing Index (CFI) was computed. The computed CFI of the 19 selected constraints ranged from 74 to 229 against a possible range of 0 to 276 which are shown in Table 4.3.

Data in Table 4.3 revealed that 'unavailability of fish fries in proper time' was major constraint for small scale aquaculture. During April to June season; when farmers need fish fries for their pond, in most cases they do not get fish fries in proper time and proper quantity. Though they get but the amount is very little, qualities are very poor and cost remain very high. So, it is a immense problem for them in practicing small scale aquaculture and this constraint ranked as first with a CFI value of 229.

'Lack of capital/sufficient fund' was second major constraints for practicing small scale aquaculture. For small scale aquaculture, farmers need instant cash money; most of the farmers' do not generally possess it. So, it is an immense problem for them in practicing small scale aquaculture and this constraint ranked as second with a CFI value of 225.

Table 4.3 Rank order of 19 selected constraints as faced by farmers in small scale aquaculture

Sl. No.	Constraints	Extent of constraints				CFI*	Rank order
		High	Moderate	Low	Not at all		
1.	Lack of capital/ sufficient fund	55	25	10	2	225	2
2.	Low profitable despite high investment	27	25	35	5	166	15
3.	Lack of scientific technical knowledge	47	25	20	0	211	5
4.	Lack of training	45	22	25	0	204	6
5.	Multi-ownership of pond	12	56	14	10	162	16
6.	Giving more preference in rice cultivation than fish culture	36	31	15	0	185	11
7.	Unavailability of fish fries in proper time	55	27	10	0	229	1
8.	Natural calamities/ hazards/ high temperature for fish culture	32	21	33	6	171	14
9.	High price of fertilizer, feed and other inputs	68	0	14	10	218	3
10.	Adulteration of feed	45	21	15	11	192	9
11.	Water crisis in dry season	40	32	17	3	201	7
12.	Security problem	50	25	17	0	217	4
13.	Inbreeding problem revealed after fry buying	35	15	42	0	177	13
14.	Occurrence of diseases	41	30	15	6	198	8
15.	Disturbance from otter and predatory birds	0	22	30	40	74	19
16.	Problem of weeds/ shedding/ sunlight	14	8	30	44	88	18
17.	Fish transportation	30	35	20	7	180	12
18.	Fluctuation of market price	11	22	59	7	136	17
19.	Fish preservation	25	46	21	10	188	10

*CFI: Constraints Facing Index

"Disturbance from otter and predatory bird", "problem of weeds/ shedding/ sunlight", "fluctuation of market price" are the last constraints i.e., 19th, 18th and 17th in the Table 4.3. CFI values of the items become 74, 88 and 136, respectively.

Constraints faced by the respondents in practicing small scale aquaculture were cross-checked through making Scored Causal Diagrams (SCDs) of Participatory Farm Management (PFM). Constraints were discussed with the respondents, assuming the 'end problem' being 'low practicing of small scale aquaculture'. Firstly, the constraints mentioned by the

respondents were listed, secondly diagrams were drawn by them on the plain ground to show causal relationships between the constraints, and finally scoring of selected constraints were performed again by them. In this way, SCDs was prepared by the group of respondents (Figure 4.2). The constraints identified by the group has been listed here with their relative importance indicated by the original score numbers as shown inside the parentheses.

End constraint: low practicing of small scale aquaculture (100)

Intermediary constraints:

- Decreased production (35)
- Lack of knowledge and experience (20)
- Lack of capital (20)
- Marketing problem (15)
- Quality loss of fish (10)

Root causes:

1. Unavailability of fish fries in proper time (20)
2. Lack of training and education (20)
3. Rigid rules for getting credit (11)
4. Lack of proper preservation (10)
5. High interest rate on credit (9)
6. Lack of proper transportation (8)
7. Occurrence of disease (8)
8. Fluctuation of market price (4)
9. Inbreeding problem (4)
10. Disturbance of otter and predatory birds (3)
11. Problems created by middle man (3)

On exploration of the root causes of small scale aquaculture, 11 root causes have been identified by the fish farmers. Among the 'root' causes 'unavailability of fish fries in proper time (20)' and 'lack of training and education' got the highest score (20)' and was the most crucial root causes. Then 'rigid rules for getting credit' was the second root cause with a score of 11. It was highly logical because lack of training caused lack of knowledge, experience and unavailability of fish fries in proper time resulting in constraints facing and accordingly there was low practicing of small scale aquaculture.

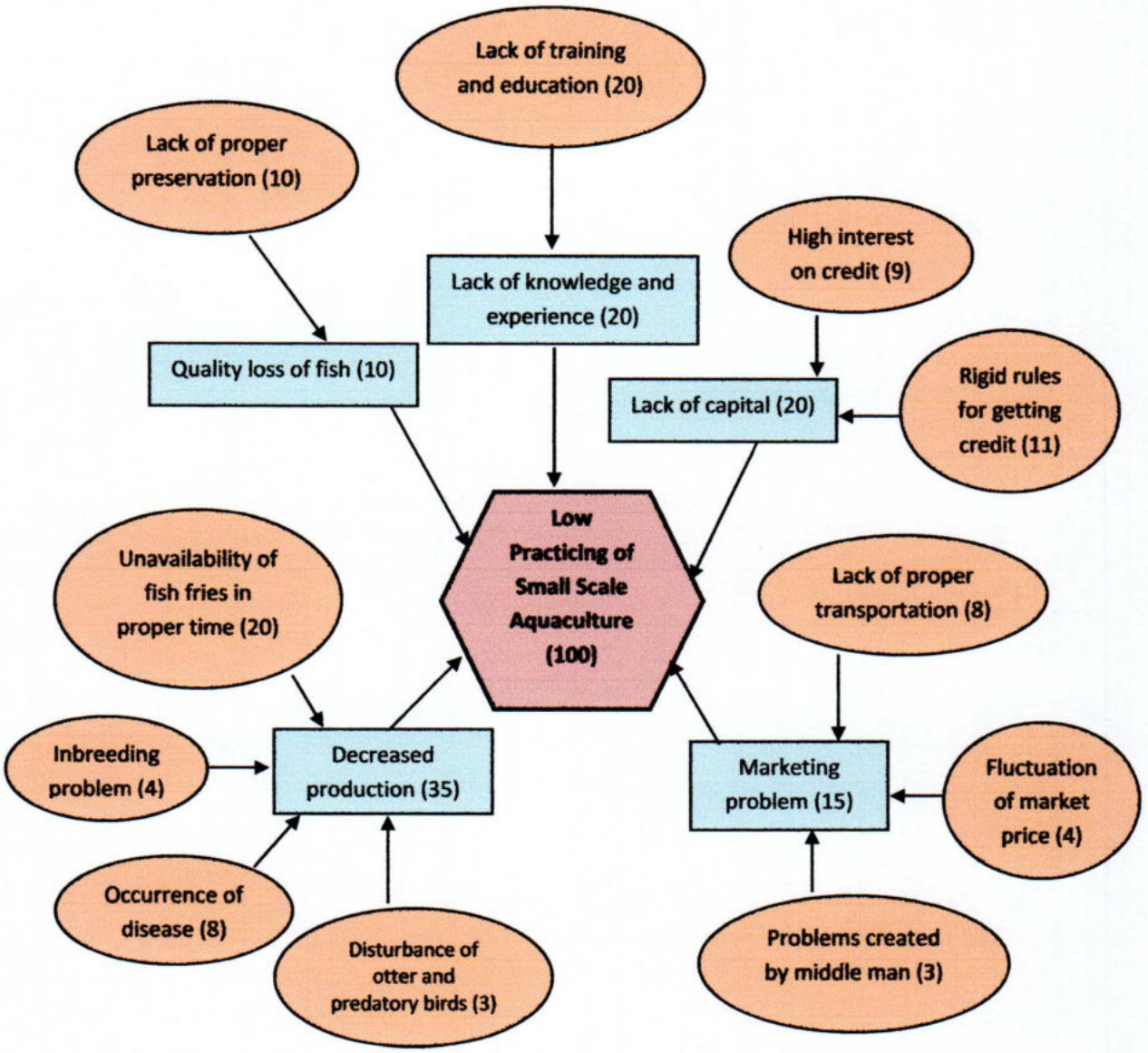

Figure 4.2 Scored Causal Diagram (SCD) prepared by the small scale aquaculture fish farmers

Though the other root causes such as 'high interest on credit', 'lack of proper transportation' and 'disturbance of otter and predatory birds' bear less significance but these could never be avoided. These cause also some sorts of influences on the low practicing of small scale aquaculture.

4.2 Selected Characteristics of the Fish Farmers

Eleven selected characteristics of the respondents were studies in this research, which were the independent variables. The descriptive statistics of the selected characteristics of the respondents have been described in the subsequent sections.

4.2.1 Age

The age of the respondents varied from 22 to 56 years with a mean and standard deviation of 36.04 and 9.11 respectively. The respondents were classified into three categories on the basis of their age: 'young' (≤35 years); 'middle aged' (36-45years) and 'old' (≥46 years). On the basis of the age, the respondents were distributed into three categories as presented in Table 4.4.

Table 4.4 Distribution of the respondents according to their age

Range (Observed)	Categories	Respondents		Mean	SD
		Frequency	Percent		
22-56	Young (≤35 years)	55	59.8	36.04	9.11
	Middle (36-45 years)	24	26.1		
	Old (≥46 years)	13	14.1		

The data contained in the Table 4.4 present that the highest proportions (59.8 percent) of the respondents were young aged compared to 26.1 percent middle aged and 14.1 percent old aged. Thus, 85.9 percent of the farmers were young to middle aged. Young and middle aged people are generally more eager to new ideas and practices and expected to face less constraint in adoption and practices of technology.

4.2.2 Educational qualification

The educational qualification score of the farmers ranged from 1 to15 with an average of 8.77 and standard deviation of 3.32. Based on their educational score, farmers were classified into three categories, namely, primary education (1-5), secondary education (6-10), above secondary (>10). The distribution of the respondents on the basis of their level of educational qualification has been presented in Table 4.5.

Table 4.5 Distribution of the respondents according to educational qualification

Range (Observed)	Categories	Respondents (N=92)		Mean	SD
		Frequency	Percent		
1-15	Primary (1-5)	23	25.0	8.77	3.32
	Secondary (6-10)	46	50.0		
	Above secondary (>10)	22	23.9		

Data presented in the above Table indicate that 25 percent had primary education 50.0 percent had secondary education and 23.9 percent were above secondary education level. Majority (75 percent) of the farmers in the study area had primary and secondary level of education. This was an encouraging literacy rate comparing the national literacy rate of 66 percent (BBS, 2011). Education helps the respondents obtain useful information related to agricultural practice, especially aquaculture through reading leaflets, booklets, books and other printed materials.

4.2.3 Family size

The minimum and maximum family size scores were 3 and 12 respectively. The average family size was 6.54 with a standard deviation 1.84. The respondents were classified into three categories like 'small family (≤5)'; 'medium family (6-8)'; 'large family (≥9)' are presented in Table 4.6.

Table 4.6 Distribution of the respondents according to family size

Range (Observed)	Categories	Respondents (N=92)		Mean	SD
		Frequency	Percent		
3-12	Small (≤5)	35	38.0	6.54	1.84
	Medium (6-8)	39	42.4		
	Large (≥9)	18	19.6		

The data furnished in the above Table revealed that 42.4 percent had medium family size, 38.0 percent of the respondents had small family size, and 19.6 percent had large family. In the study area, it was observed that, fish farmers with medium to large family size generally engage in various types of activities. The number of medium to large families gets time to work with fish farming after completing their own family work. So, medium and large family group were most effective for the fish production.

4.2.4 Farm size

Farm size of the respondents varied from 0.47 to 5.35 hectares with the mean value of 1.34 hectares and standard deviation of 0.84. Based on farm size manual (DAE, 1996), the farmers were classified into following categories as Landless (<0.02), Marginal (0.02-0.2), small (0.2-1.0), medium (1.0-3.0) and large (>3.0).

Table 4.7 Distribution of the respondents according to farm size

Range (Observed)	Categories	Respondents (N=92)		Mean	SD
		Frequency	Percent		
0.47-5.35	Landless (<0.02)	0	0	1.34	0.84
	Marginal (0.02-0.2)	0	0		
	Small (0.2-1.0)	43	46.7		
	Medium (1.0-3.0)	44	47.8		
	Large (>3.0)	5	5.4		

The data in the Table 4.7 revealed that the majority of the respondents (47.8 percent) had medium farm size, 46.7 percent small farm size and 5.4 percent had large farm size.

The information indicates that majority of the respondents were in small and medium farm size categories. It is predictable that constraints faced by these two categories of fish farmers would be higher.

4.2.5 Area under aquaculture

Area under aquaculture of the respondents ranged from 0.04 to 1.34 hectares with a mean of 0.30 and standard deviation of 0.27. The farmers were classified into three categories which have been shown in Table 4.8.

Table 4.8 Distribution of the respondents according to area under aquaculture

Range (Observed)	Categories	Respondents (N=92)		Mean	SD
		Frequency	Percent		
0.04-1.34	Very Small (<0.5)	75	81.5	0.30	0.27
	Small (0.5-0.57)	4	4.3		
	Medium (≥0.58)	13	14.1		

Data presented in the above Table indicated that 81.5 percent had very small aquaculture area, 14.1 percent had medium aquaculture area and only 4.3 percent had small aquaculture area. The topography of Thakurgaon district is high. So, the number and size of pond is very small. Thus, majority of the farmers had small aquaculture area.

4.2.6 Knowledge of aquaculture

Knowledge of aquaculture score of the farmers ranged from 21 to 44 against the possible ranged from 0 to 46 with a mean of 36.55 and standard deviation of 4.95. Based on aquaculture knowledge score, the farmers were classified into three categories as were shown in Table 4.9.

Table 4.9 Distribution of the respondents according to knowledge of aquaculture

Range		Categories	Respondents		Mean	SD
Possible	Observed		Frequency	Percent		
0-46	21-44	Low (up to31)	18	19.6	36.55	4.95
		Medium (32-42)	69	75.0		
		High (≥43)	5	5.4		

Exactly three fourth of the respondents (75.0 percent) had medium aquaculture knowledge, while 19.6 percent had low and 5.4 percent had high aquaculture knowledge. The fish farmers of the study area received training on practicing aquaculture from Upazila Fisheries Office and local NGOs in a regular interval. At the same time, they involve in different types of aquaculture activities throughout the year. During involvement, a farmers needs to come close contact to extension agents and other resource person regularly. All these might have contributed farmers to have moderate to high aquaculture knowledge.

4.2.7 Annual income

The annual income scores of the farmers ranged from 102 to 600 thousand Taka, the average being 275.12 thousand Taka and standard deviation 121.26 thousand Taka. On the basis of annual income the farmers were classified into three categories, such as 'low income' (up to 154 thousand Taka); 'medium income' (155-396 thousand Taka), and 'high income' (above 396 thousand Taka). The categories and distribution of the respondents according to their annual income have been presented in Table 4.10.

Table 4.10 Distribution of the respondents according to annual income

Range (Observed)	Categories	Respondents		Mean	SD
		Frequency	Percent		
102-600	Low income (up to 154)	14	15.2	275.12	121.26
	Medium income (155-396)	64	69.6		
	High (>396)	14	15.2		

The data in the Table 4.10 showed that 69.6 percent had medium annual income, 15.2 percent of the farmers had low annual income, and 15.2 percent had high annual income. The majority (84.8 percent) of the respondents had medium to high annual family income. The sources of income of respondents were fish farming, selling agricultural product, services, business and other sources. The finding gives the indication that as the respondent's annual income was fairly good, they faced low constraints in small scale aquaculture.

4.2.8 Income from Aquaculture

The respondents 'sources for income from aquaculture of (in terms of percentage of total income) ranged from 2.70 to 55.55 thousand Taka, with an average of 16.82 thousand Taka and standard deviation of 10.68 thousand Taka. On the basis of their income from and dependency aquaculture, the respondents were classified into three categories, namely low income (up to 6 thousand Taka), medium income (7-28 thousand Taka) and high income (above 28 thousand Taka) as shown in Table 4.11.

Table 4.11 Distribution of the respondents according to income from aquaculture

Range (Observed)	Categories	Respondents		Mean	SD
		Frequency	Percent		
2.70-55.55	Low (up to 6)	8	8.7	16.82	10.68
	Medium (7-28)	63	68.5		
	High (>28)	14	15.2		

The data in the above table revealed that 68.5 percent had medium income followed by 15.2 percent had high income and 8.7 percent of the farmers had low income from aquaculture. The land under aquaculture of the study area was very high productive and the fish farmers culture various types fish mainly demanding for market.

4.2.9 Training received

The training received scores of the respondents ranged from 0 to 8 with a mean of 2.24 and standard deviation of 2.98. According to the training received, respondents were classified into four categories like 'No training' (0 days); 'low training' (1-3 days); 'moderate training' (4-6 days) and 'long training' (7-8 days) as presented in Table 4.12.

Table 4.12 Distribution of the respondents according to their training received

Range (Observed)	Categories	Respondents		Mean	SD
		Frequency	Percent		
0-8	No training (0 days)	55	59.8	2.24	2.98
	Low training (1-3 days)	3	3.3		
	Moderate training(4-6 days)	25	27.2		
	Long training (7-8 days)	9	9.8		

Data presented in the Table 4.12 revealed that majority (59.8 percent) of the respondents had no training on small scale aquaculture followed by 27.2 percent of the respondents received moderate training, 9.8 percent received long training and 3.3 percent had low training. Training plays an important role in motivating the individuals and encourages them to participate in small scale aquaculture. Training increases skills and knowledge about the aquaculture technologies of the farmers which makes the respondents much more competent in performing different aquaculture activities.

4.2.10 Extension media contact

The extension media contact score of the respondents varied from 11 to 29 against a possible score of 0 to 30. The mean is 24.12 and standard deviation is 4.71.

Table 4.13 Distribution of the respondents according to extension media contact

Range		Categories	Respondents		Mean	SD
Possible	Observed		Frequency	Percent		
0-30	11-29	Low (up to 19)	16	17.4	24.12	4.71
		Medium (20-29)	69	75.0		
		High (>29)	7	7.6		

On the basis of extension media contact score the respondents were classified into three categories as shown in Table 4.13. Majority of the respondents (75.0 percent) had medium, while 17.4 percent had low and 7.6 percent had high extension media contact.

A large number of farmers had medium extension media contact in the study area. This is due to the fact that the extension agent merely contacts with the farmers as and when necessary. On the other hand, unconscious rural farmers did not maintain regular contact with the extension agent. Therefore, few of the respondents have high extension media contact.

4.2.11 Organizational participation

The computed organizational participation score of the respondents ranged from 0 to 20 with an average of 10.09 and standard deviation of 2.63. On the basis of organizational participation score, the respondents were classified into three categories like Low (up to 7), medium (8-13) and high (>13) as shown in Table 4.14.

Table 4.14 Distribution of the respondents according to their organizational participation

Range		Categories	Respondents		Mean	SD
Possible	Observed		Frequency	Percent		
0-20	5-18	Low (up to 7)	15	16.3	10.09	2.63
		Medium (8-13)	67	72.8		
		High (>13)	10	10.9		

Data in the above table indicate that 72.8 percent had medium, 16.3 percent had low, and 10.9 percent had high organizational participation. The farmers with more organizational participation scores are expected to use more communication media in receiving information on practicing aquaculture.

4.3 Relationships between the Selected Characteristics of the Farmers and their Constraints in Small Scale Aquaculture

The purpose of this section is to examine the relationship between the selected characteristics of the farmers and the constraints faced by them in small scale aquaculture. The characteristics included age, education qualification, family size, farm size, area under aquaculture, knowledge of aquaculture, annual income, income from aquaculture, training received, extension media contact and organizational participation. Each of the characteristics constituted an independent variable, while constraints faced by the farmers in small scale aquaculture were the only dependent variable of the study. Co-efficient of correlation (r) was used to explore if there was statistical significant relationship between the selected of the farmers characteristics and their constraints. The summary results of correlation test is presented in Table 4.15 and the correlation matrix appears in the Appendix –B.

Results in Table 4.15 revealed that farm size, area under aquaculture, knowledge of aquaculture, training received and extension media contact were negatively correlated with the farmers' constraints in small scale aquaculture. The remaining characteristics (age, educational qualification, family size, annual income, income from aquaculture and organizational participation) of the respondents did not show any relationship with their constraints in small scale aquaculture. The results of all correlation test have been discussed in the subsequent sections.

Table 4.15 Relationships between the selected characteristics of the farmers and their constraints in small scale aquaculture (N = 92)

Selected Characteristics	Correlations 'r' values with 90 d. f.
Age	-0.030
Educational qualification	-0.082
Family size	-0.057
Farm size	-0.330**
Area under aquaculture	-0.206*
Knowledge of aquaculture	-0.275**
Annual income	-0.132
Income from aquaculture	0.037
Training received	-0.426**
Extension media contact	-0.223*
Organizational participation	-0.005

** Correlation is significant at the 0.01 level

* Correlation is significant at the 0.05 level

4.3.1 Relationship between age and constraints in small scale aquaculture

The computed value of the co-efficient of correlation (r) between age of the farmers and their constraints in small scale aquaculture was found to be -0.030 as shown in Table 4.15. This indicated a non-significant negative relationship between age of the farmers and their constraints in small scale aquaculture. Thus, the null hypothesis was accepted which implied that there was no relationship between the age of the farmers and their constraints in small scale aquaculture. Similar relationship was found by Parvez (2009), Hasan and Anwarul (2005) and Nahid (2005).

4.3.2 Relationship between education qualification and constraints in small scale aquaculture

The correlation co-efficient between educational qualification and their constraints in small scale aquaculture was not significant (-0.082) as shown in Table 4.15. So, the concerned null hypothesis was accepted, which implies that there was no direct relationship between the educational qualification of farmers and their constraints in small scale aquaculture. Similar relationship was found by Hasan and Anwarul (2005), Halim (2003) and Haque (2001).

4.3.3 Relationship between family size and constraints in small scale aquaculture

The correlation co-efficient (r) between family size and their constraints in small aquaculture of farmers was (-0.057) as shown in Table 4.15. Based on the computed 'r ' value, the relationship between the concerned variable was no direct relationship. Thus, the null hypothesis was accepted. So, it may be concluded that there was no significant relationship between the family size of the farmers and their constraints in small scale aquaculture. Similar relationship was found by Halim (2003) and Rashid (1999).

4.3.4 Relationship between farm size and constraints in small scale aquaculture

The calculated value of correlation coefficient between farm size and their constraints in small scale aquaculture was negatively significant (-0.330) as shown in Table 4.15. So, the concerned null hypothesis was rejected. Thus, it may be concluded that farmers with larger farm were likely to have lower of constraints in small scale aquaculture. Similar relationship was found by Nahid (2005) and Hasan and Anwarul (2005).

4.3.5 Relationship between area under aquaculture and constraints in small scale aquaculture

The calculated value of correlation coefficient between area under aquaculture and their constraints in small scale aquaculture was (-0.205) as shown in the table 4.15. Based on the calculated ' r' value, the relationship between the concerned variables was negatively significant; the concerned null hypothesis was rejected. Thus the findings revealed that larger the area under aquaculture of small scale aquaculture the lower was their faced constraints. Similar relationship was found by Nahid (2005).

4.3.6 Relationship between Knowledge of aquaculture and their constraints in small scale aquaculture

The calculated value of correlation coefficient between knowledge of aquaculture and their constraints in small scale aquaculture was negatively significant (-0.275) as shown in Table 4.15. So, the concerned null hypothesis was rejected. Thus, it may be concluded that farmers with higher aquaculture knowledge were likely to have lower level of constraints in small scale aquaculture. Similar relationship was found by Parvez (2009) and Karmaker (2004).

4.3.7 Relationship between annual income and their constraints in small scale aquaculture

The calculated value of correlation coefficient between farm size and their constraints in small scale aquaculture was no significant relationship (-0.132) as shown in Table 4.15. Hence the null hypothesis was not rejected. This means that annual income of the respondents and their constraints in small scale aquaculture are independent to each other. Thus, it may be concluded that farmers with higher the family annual income of small scale aquaculture farmers the lower was there faced constraints. Similar relationship was found by Noman (2012).

4.3.8 Relationship between income from aquaculture and their constraints in small scale aquaculture

The calculated value of correlation coefficient between income from aquaculture and their constraints in small scale aquaculture of farmers was no significant (0.037) as shown in Table 4.15. Hence the null hypothesis was accepted. So, it was concluded that there was no significant relationship between income from aquaculture and their constraints in small scale aquaculture.

4.3.9 Relationship between training received and their constraints in small scale aquaculture

The correlation coefficient between training received and their constraints in small scale aquaculture of farmers was negatively significant (-0.426) as shown in Table 4.15. Thus, the concerned null hypothesis was rejected. On the above findings, it may be concluded that training received of the small scale aquaculture farmers has a significant negative effect on their faced constraints. The findings indicated that higher the training received of the small scale aquaculture farmers the lower was their faced constraints. These small scale aquaculture farmers get directly different aquaculture training by the different government and NGO agencies, and can overcome their constraints. Similar relationship was found by Halim (2003) and Ahmed (2002).

4.3.10 Relationship between extension media contact and constraints in small scale aquaculture

The correlation coefficient between extension media contact and their constraints in small scale aquaculture of farmers was negative significant (-0.223) as shown in Table 4.15. Thus, the concerned null hypothesis was rejected. On the above findings, it may be concluded that extension media contact of the small scale aquaculture farmers has a significant negative effect on their faced constraints. The findings indicated that higher the extension media contact of the small scale aquaculture farmers the lower was their faced constraints. These small scale aquaculture farmers directly or indirectly get exposure of different aquaculture and non- aquaculture entrepreneurial technology and can overcome their constraints. Similar relationship was found by Parvez (2009), Salam (2003) and Bhuyian (2002).

4.3.11 Relationship between organizational participation and constraints in small scale aquaculture

The calculated value of correlation coefficient between organizational participation and constraints in small scale aquaculture was not significant (-0.005). Thus, the null hypothesis was rejected. Base on the above finding, the researcher concluded that the organizational participation of the small scale aquaculture farmers had no relationship between organizational participation and constraints in small scale aquaculture. Similar relationship was found by Parvez (2009).

4.4 Perceived Scope for Practicing Small Scale Aquaculture

The respondents expressed their opinion regarding scope for practicing small scale aquaculture and the "Perception Index of Scope" i. e. PIS (cf. chapter 3) has been presented in Table 4.16.

Table 4.16: Perception Index of Scope (PIS) for practicing small scale aquaculture

Sl. No.	Statements	Extent of perception of scope				PIS	Rank
		High	Moderate	Low	Not at all		
1.	Small scale aquaculture is profitable	78	14	0	0	262	1
2.	Marketing facilities	51	22	14	5	211	4
3.	Nutritional requirement	75	14	2	1	256	2
4.	Employment opportunity for youth	74	16	3	0	254	3
5.	Sustainability of the small scale aquaculture	26	44	16	6	182	5

Attempts were made to ascertain the perception index of scope for practicing small scale aquaculture.

1. Small scale aquaculture is profitable

As the prospects for ever-increasing rice yields have become less viable, aquaculture has grown quickly to become the second-most valuable food source in Bangladesh (World Bank, 2013). Farmed tilapia production increased from 4,000 to 138,000 metric tons between 2002 and 2012 (Financial Express, 2013). By 2015, production is expected to reach 150,000 metric tons. Fish (including shrimp and prawn) is the second most valuable agricultural crop in Bangladesh. Official statistics estimate total fish production of 3.26 million tons, of which aquaculture accounts for 39%, or 1.06 million (DoF, 2013). Today people are more willing to invest in aquaculture sector for its profitable production. This is the reason; it appeared as 1st position with PIS of 262.

2. Marketing facilities

Fish marketing is almost entirely a function of the private sector and operates through a complex system of village markets (hat), township markets (bazar), assembly centers, major urban wholesale and retail markets. There is a corresponding network of personnel, from buyers who may be hat traders or agents of bigger bazar fish merchants (Bepari/Mahajan) to wholesale market commission agents (Aratdar/Paikar) who effectively control the whole system. The fishermen are compelled to hand over their catches to the trader/middleman (Aratdar/Paikar) at a price determined by the latter. Fish marketing is very easy in Bangladesh. Today fish farmers are sold their fish at the pond site after harvest. Due to good road transportation fish farmers can easily be transported their produced at nearby or district level market. In the study area, most of the farmers sold their fish at town level market. That is why; this statement becomes the 4th position with PSI of 211.

3. Nutritional requirements

The people of Bangladesh have traditionally been identified with fish and rice, which constitute the major items of their daily diet and fish ranks as the second staple food in their diet. Fish is an important source of protein. Fish is leaner than meat i.e. lower fat, and contains amino acids and minerals that are vital to the body. So, small scale aquaculture play an important role for fulfill nutritional requirement. Thus, this statement becomes 2nd in the ranking with 256.

4. Employment opportunity for youth

The world is facing a worsening youth employment crisis, young people are almost three times more likely to be unemployed than adults (ILO, 2013). If youth can engage in small scale aquaculture, there is a great scope for improving themselves and improving their financial and livelihood status. They can also have intermediary business scope by the fishery product. This is the reason; it appeared as 3rd position with PIS of 254.

5. Sustainability of small scale aquaculture

Sustainability could be defined as an ability or capacity of something to be maintained or to sustain itself. It's about taking what we need to live now, without jeopardizing the potential for people in the future to meet their needs.

Aquaculture is the fastest growing food production sector for the last decade, and there is significant potential for continued expansion and growth o aquaculture and culture based fisheries. It has been proven that aquaculture and inland fisheries have played and will continue to play an important role in human nutrition and poverty alleviation in many rural areas through integrated aquaculture-agriculture farming systems and integrated utilization of small and medium sized water bodies. Aquaculture is also facing the challenge of sustainable development. To reduce the environmental impacts of aquaculture development as well as avoid impacts on aquaculture caused by non-aquaculture activities, both a result of poor management, further efforts are needed to improve resources use and appropriate environmental management. However, extensive and semi-intensive practices are likely to continue to be the most important for small scale aquaculture. In the study, the farmers mentioned it at 5th PIS with the score 182.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Findings

This study was undertaken to assess the extent of constraints and perceived scope for practicing small scale aquaculture and to explore the relationships between the farmer's constraints and their selected characteristics. The study was carried out in Ranisankail upazila under Thakurgaon district. Ninety two (92) respondents were selected as sample from an updated list of 276 fish farmers using random sampling method. Data were collected by a pre-tested interview schedule during 1st March to 30th April 2014. A summary of the major findings was presented in the subsequent sections.

5.1.1 Constraints for practicing small scale aquaculture

The overall constraints scores of the respondents ranged from 26 to 52 against the possible range of 0 to 57. The average constraints score was 42.14 and standard deviation is 5.67. Slightly around three-fourths (72.8 percent) of the respondents had medium constraints, 18.5 percent had low constraints and only 8.7 percent had high constraints for practicing small scale aquaculture.

The Constraints Facing Index (CFI) scores of the 19 constraints ranged from 74 to 229 against a possible range from 0 to 257. 'Unavailability of fish fries in proper time' was major constraints occupied the highest CFI (229) scores and stand top in the ranking while 'Disturbance from otter and predatory birds' showed lowest score (CFI=74) occupying the last position in the ranking.

Majority of the farmers constraints in three aspects i.e., general constraints (66.3 percent), fish-culture constraints (68.5 percent) and post-harvest constraints (62.0 percent) had faced medium constraints level.

5.1.2 Selected characteristics of the respondents

Age

The age of the respondents varied from 22 to 56 years with a mean and standard deviation of 36.04 and 9.11 respectively. The highest portion (59.8 percent) of the respondents was young compared to 26.1 percent middle aged and 14.1 percent old categories.

Educational qualification

The educational qualification score of the farmers ranged from 1 to 15 with a mean of 8.77 and standard deviation 3.32. The majority respondents (50.0 percent) had secondary education, 25 percent had primary education and 23.9 percent had above secondary educational qualification level. Majority (75 percent) of the farmers in the study area had primary to secondary level of education.

Family size

The minimum and maximum family size scores were 3 and 12 respectively. The mean was 6.54 with a standard deviation of 1.84. The majority (42.4 percent) had medium family size, 38.0 percent of the respondents had small family size, and 19.6 percent had large family size.

Farm size

Farm size of the respondents varied from 0.47 to 5.35 hectares with a mean of 1.34 hectares and standard deviation 0.84. The majority of the respondents (47.8 percent) had medium farm size, 46.7 percent small farm size and 5.4 percent had large farm size.

Area under aquaculture

Area under aquaculture of the respondents ranged from 0.04 to 1.34 hectares with a mean of 0.30 hectares and standard deviation of 0.27. More than three-fourths of the respondents (81.5 percent) had very small aquaculture area, 14.1 percent had medium aquaculture area and 4.3 percent had small aquaculture area.

Knowledge of aquaculture

Knowledge of aquaculture score of the farmers ranged from 21 to 44 against the possible ranged from 0 to 46. The average score was 36.55 and standard deviation was 4.95. Three-fourth of the respondents (75.0 percent) had medium aquaculture knowledge, while 19.6 percent had low and 5.4 percent had high aquaculture knowledge.

Annual income

The annual income of the farmers ranged from 102 to 600 thousand, the average 275.12 thousand and standard deviation 121.26. Majority (69.6 percent) had medium annual income, 15.2 percent of the farmers had low annual income and 15.2 percent had high annual income. The vast majority (84.8 percent) of the respondents had medium to high medium annual family income.

Income from aquaculture

The respondents' scores for income from aquaculture (in terms of percentage of total income) ranged from 2.70 to 55.55, with an average of 16.82 and standard deviation of 10.68. Majority (68.5 percent) had medium income 15.2 percent had high income from aquaculture and 8.7 percent of the farmers had low income from aquaculture.

Training received

The training received scores of the respondents ranged from 0 to 8 with a mean of 2.24 and standard deviation of 2.98. Majority (59.8 percent) of the respondents received no training on small scale aquaculture followed by 27.2 percent of the respondents received moderate training, 9.8 percent long training and 3.3 percent had low training.

Extension media contract

The extension media contact score of the respondents varied from 11 to 29 against a possible score ranged from 0 to 30. The mean 24.12 and standard deviation was 4.71. Majority (75.0 percent) of the respondents had medium and medium, while 17.4 percent had low and 7.6 percent had high extension media contact.

Organizational participation

The computed organizational participation score of the respondents ranged from 0 to 20 with an average of 10.09 and standard deviation of 2.63. The respondents of 72.8 percent had medium, 16.3 percent had low and 10.9 percent had high organizational participation.

5.1.3 Relationship between selected characteristics and constraints for practicing small scale aquaculture

Eleven null hypotheses were tested to explore the relationships between the selected characteristic of the respondents and constraints for practicing small scale aquaculture. Out of eleven tested null hypotheses, five were rejected. These were farm size, area under aquaculture, knowledge on aquaculture, training received and extension media contact for practicing small scale aquaculture of the respondents revealed negative significant relationships with the constraints for practicing small scale aquaculture. On the other hand, age, educational qualification, family size, annual income, income from aquaculture and organizational participation of the respondents did not show any significant relationship with the constraints for practicing small scale aquaculture.

5.1.4 Perceived Scope for practicing small scale aquaculture

The respondents mentioned their opinion on five perceived scopes for practicing small scale aquaculture. 'Small scale aquaculture is profitable' ranked first followed by 'Nutritional requirement' obtaining PIS of 262 and 256, respectively. 'Sustainability of the small scale aquaculture' becomes lowest in the perception index of scope with PIS of 182.

5.2 Conclusions

Conclusions drawn on the basis of the findings and their logical interpretation in the light of the other relevant facts are presented below:

1. The study determined the extent of constraints faced by the farmers for practicing small scale aquaculture in three aspects, namely general constraints, fish-culture constraints and post-harvest constraints. Regarding overall constraints of practicing small scale aquaculture, about three-fourths (72.8 percent) of the farmers faced medium constraints. Therefore, the constraints of practicing small scale aquaculture would not be minimized unless the capacity of farmers is adequately improved by the help of fisheries organization.

2. Farm size had a negative significant relationship with their constraints for practicing small scale aquaculture. This leads to conclude that the larger the farm size the less will be their constraints in small scale aquaculture.

3. Knowledge of aquaculture and extension media contact had a negative significant relationship with their constraints and hence, it may be concluded that with the increase of extension media contact with farmers would increase their knowledge and skill, and ultimately decrease constraints for practicing small scale aquaculture.

4. Training received and constraints of the farmers had significant negative relationship. It may be concluded that farmers having higher training received decrease constraints for practicing small scale aquaculture.

5.3 Recommendations

5.3.1 Recommendations for policy implementation

On the basis of the findings and conclusion of the study, the following recommendations for policy implementation are made.

1. As majority of the farmers were found to face medium constraints in practicing small scale aquaculture, The Ministry of Fisheries concerned departments should carefully observe the socioeconomic situation of the small scale aquaculture in the study area and come up with appropriate programs that the farmers can maximize their profit from aquaculture.

2. The government should take some measures for ensuring easy availability of inputs at reasonable prices.

3. Proper guidance and necessary help should be given to small fish farmers so that they can overcome their constraints of the financial inability. The concerned authorities should increase the availability of credit from any commercial banks or NGOs with low interest.

4. The DoF and other NGOs should strengthen their extension services to overcome their constraints. In case of extension services, adequate motivational program through meeting at result demonstration, group discussion and other educational activities should provide for practicing small scale aquaculture to increase farmers' knowledge and extension media contact.

5. The DoF and other organization involved in aquaculture in Thakurgaon district should provide training and proper counseling to remove the constraints faced by the small scale aquaculture farmers.

5.3.2 Recommendations for further study

1. The present study was conducted in four unions of Ranisankail upazila under Thakurgaon district. Similar study may be undertaken in other parts of the country, which could be helpful for more understanding and generalization of the issues.
2. The present investigation included three aspects of constraints in practicing small scale aquaculture. There is a need for investigation of the constraints faced by the farmers in other possible and potential aspects, such as: constraints related to technology, constraints with research system etc. Again, each of these aspects of constraints may be taken as individual aspect of the study.
3. The present study explored the relationships of eleven independent variables with constraints faced for practicing small scale aquaculture. Further research may be conducted by selecting other independent variables to observe relationships with constraints.
4. Review of literature indicated that there is no direct research especially attitude of farmers towards small scale aquaculture. Further research may be conducted on the farmers' attitude towards small scale aquaculture.
5. The study was conducted at the farmer's level. Similar study may be conducted by taking subject from the change agents to assess their knowledge on small scale aquaculture.
6. Constraints for practicing Small scale aquaculture i.e. dependent variable and eleven selected characteristics of the respondents' i.e. independent variables relationship was determined by using only correlation co-efficient method which showed the relationships between the selected characteristics concerned and not 'cause and effect' relationship. Thus, to determine the other phenomena, it is necessary and recommended that other sophisticated research design using higher level of parametric measurement be implemented.

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APPENDIX-A

Department of Agricultural Extension

Hajee Mohammad Danesh Science and Technology University, Dinajpur

An interview schedule on **"Constraints and Perceived Scope for Practicing Small Scale Aquaculture"**

Serial no.: . . . . . .

a) Name of the respondent: . . . . . .

b) Village: . . . . . c) Union: . . . . . .

d) Upazilla: . . . . . .e) District: . . . . . .

(Please answer the following questions and put tick (√) whenever necessary)

1. Age: What is your present Age?. . . . . years.

2. Educational qualification

(Please mention your educational qualification)

a) I can't read and write ☐

b) I can sign name only ☐

c) I have studied up to class (.....)

3. Family size

Please mention your total number of family members (including yourself):

Family member	Numbers
Male	
Female	
Total=	

4. Farm size

Please mention your land area under the following nature of holding:

Sl. No.	Types of land use	Local unit	Standard unit (ha.)
1.	Homestead land		
2.	Own land under own cultivation		
3.	Share cropping/Leased/Mortgaged in/ Pond taken from others on share		
4.	Share cropping/Leased/Mortgaged out/ Pond taken from others on lease		
5.	Pond area		
6.	Others (specify)		
	Total=		
Total farm size= F_1+ F_2+1/2 (F_3+F_4)+F_5+F_6			

5. Area under aquaculture

Please furnish information about your pond:

Sl. No.	Pattern of ownership of pond	Pond area	
1.	Own pond	Local unit	Standard unit (ha.)
2.	Pond taken from others on share		
3.	Pond taken from others on lease		
	Total=		

6. Knowledge of aquaculture

Please answer the following questions:

Categories	Questions	Weight score	Marks obtained
Remembering	Name two most profitable fish varieties for culture in ponds.	2	
	Name two predatory fish species.	2	
	Name two most important feed stuff for fish feed preparation.	2	
Understanding	Mention two characteristics of good quality fish fry.	2	
	What is the need to use fertilizer in pond?	2	
	What type of pond soil is good for fish culture?	3	
Applying	How do you control weeds, predatory fishes and other aquatic animals in the ponds?	2	
	Why do you apply supplementary fish feed in your ponds?	2	
	How water can be stored in dry season?	3	
Analyzing	Sometimes bubbles come out from the bottom of the ponds, why does it occur?	3	
	What should be the water color of a productive pond?	3	
	Sometimes fish float on the surface of water, why does it occur?	3	
Evaluating	Why use of commercial fish feed is profitable than traditional supplementary feed?	3	
	Why mono sex Tilapia is profitable than both sex?	3	
	Why should nursery management is profitable than grow out farming?	3	
Creating	What measures should be taken for making a dereliction pond to cultivable pond?	3	
	What do you do when there is no available water in your paddy plots with fish/	2	
	What policy can be taken to protect fish from flood?	3	
	Total=	46	

7. Annual income

Please mention your annual family income from different sources:

Sl. No.	Sources of income	Production	Price (Tk.)
	A. Agriculture		
1.	Cereal crops (rice, wheat, maize etc.)		
2.	Vegetables (potato and others)		
3.	Spices / pulse /oil seed crops		
4.	Cash crops (jute , sugarcane and tobacco)		
5.	Poultry		
6.	Cattle (cow, buffalo and goat rearing) and milk		
7.	Aquaculture / fisheries		
8.	Others		
	B. Occupation		
1.	Service		
2.	Business/ small business		
3.	Other occupation (selling labour)		
4.	Safety net (VGD/VGF, food for work etc.) allowance		
5.	Charity (fitra, jakat, help etc.)		
6.	Others		
	C. Other family members		
	Total income: A+B+C=		

8. Income from aquaculture (% of total income):

9. Training received

Please mention your training status:

- o Yes
- o No

If yes, please mention your extent of training

Sl. No.	Name of the training	Duration (Day)	Sponsoring agency

10. Extension media contact

Please mention your extent of contact with the following media:

Sl. No.	Communication media	Extent of contact			
		Regularly	Occasionally	Very Low	Never
1.	Progressive farmers / model farmers	≥ 5 times/week	3-4 times/week	1-2 times/week	
2.	Upazila Fisheries Officer (UFO)	Do	Do	Do	
3.	NGO Workers	≥ 6 times/season	4-5 times/season	1-3 times/season	
4.	Training meeting	≥ 2 times/year	1 time/year	1 time/2 year	
5.	Result demonstration	≥ 2 times/year	1 time/year	1 time/2 year	
6.	Field day / Farm Rally	Do	Do	Do	
7.	Poster/ Leaflet / booklet	≥ 4/year	2-3/year	1/year	
8.	Newspapers	Do	Do	Do	
9.	Watching agricultural TV program	≥ 5 times/month	2-4 times/month	1 time/month	
10.	Agricultural Radio Programme	≥ 2 times/year	1 time/year	1 time/2 year	

11. Organizational participation

Please indicate your involvement in the following social organizations:

SL. No.	Name of the organization	Natural of Participation						
		Not at all	As a general member		As an executive member		As an executive officer	
1.	Samabay Samity (SS)		Yes	Duration	Yes	Duration	Yes	Duration
2.	Village committee							
3.	Bazar committee							
4.	Mosque committee							
5.	Madrasa committee							
6.	School committee							
7.	NGO committee							
8.	Local government organization							
9.	Village defense party							
10.	Others (if any)							

12. Constraints in small scale aquaculture

Please indicate the extent of following constraints faced in small scale aquaculture:

A. General constraints:

Sl. No.	Name of the constraints	Extent of constraints			
		High (3)	Medium (2)	Low (1)	Not at all(0)
1.	Lack of capital/ sufficient fund				
2.	Low profitable despite high investment				
3.	Lack of scientific technical knowledge				
4.	Lack of training				
5.	Multi-ownership of pond				
6.	Giving more preference in rice cultivation than fish culture				

B. Fish-culture constraints:

Sl. No.	Name of the constraints	Extent of constraints			
		High (3)	Medium (2)	Low (1)	Not at all (0)
1.	Unavailability of fish fries in proper time				
2.	Natural calamities/hazards/high temperature for fish culture				
3.	High price of fertilizer, feed and other inputs				
4.	Adulteration of feed				
5.	Water crisis in dry season				
6.	Security problem				
7.	Inbreeding problem revealed after fry buying				
8.	Occurrence of diseases				
9.	Disturbance from otter and predatory birds				
10.	Problem of weeds / shedding / sunlight				

C. Post-harvest constraints:

Sl. No.	Name of the constraints	Extent of constraints			
		High (3)	Medium (2)	Low (1)	Not at all (0)
1.	Fish transportation				
2.	Fluctuation of market price				
3.	Fish preservation				

13. Perceived scope of practicing small scale aquaculture

Please mention your extent of perception of scope:

Sl. No.	Statements	Extent of perceived of scope			
		High	Moderate	Low	Not at all
1.	Small scale aquaculture is profitable				
2.	Marketing facilities				
3.	Nutritional requirement				
4.	Employment opportunity for youth				
5.	Sustainability of the small scale aquaculture				

Thank you for your kind cooperation.

.....
Signature of interviewer

APPENDIX-B

Correlations Matrix

	Age	Educational qualification	Family size	Farm size	Area under aquaculture	Knowledge of aquaculture	Annual income	Income from aquaculture	Training received	Extension media contact	Organizational participation	Dependent variable
Age	1											
Educational qualification	-0.330**	1										
Family size	0.527**	0.013	1									
Farm size	0.398**	-0.016	0.343**	1								
Area under aquaculture	0.256*	0.192	0.248*	0.742**	1							
Knowledge on aquaculture	0.098	0.254*	0.207*	0.293**	0.298**	1						
Annual income	0.435**	0.010	0.452**	0.658**	0.558**	0.281**	1		0.250*			
Income from aquaculture	0.075	0.103	0.105	0.439**	0.645**	0.293**	0.241*	1	0.002			
Training received	0.180	0.078	0.132	0.133	0.149	0.061			1			
Extension media contact	-0.111	0.128	0.062	0.196	0.210*	0.414**	0.312**	0.318**	0.189	1		
Organizational participation	0.315**	0.034	0.307**	0.274**	0.310**	0.246*	0.463**	0.146	0.073	0.432**	1	
Constraints in small scale aquaculture	-0.030	-0.082	-0.057	-0.330**	-0.206*	-0.275**	-0.132	0.037	-0.426**	-0.223*	-0.005	1

** Correlation is significant at the 0.01 level

* Correlation is significant at the 0.05 level